

### **REMARKS**

The above amendments are made in response to the Office action of July 20, 2010. Claims 1-11 are pending in the present Application. Claims 1 and 3 have been amended, claim 2 has been cancelled, and claim 10 withdrawn, leaving Claims 1, 3-9 and 11 for consideration upon entry of the present Amendment.

Support for the amendments to claim 1 can be found at least in claim 2 as originally filed. Claim 1 has also been amended for proper antecedent basis. Claim 3 has been amended to depend from claim 1. Reconsideration and allowance of the claims are respectfully requested in view of at least the above amendments and the following remarks.

### **Election/Restrictions**

The Applicants thank the Examiner for acknowledging the election of Group 1 in the reply filed April 19, 2010. Accordingly, the Applicants understand that claim 10 has been withdrawn.

### **Claim Rejections Under 35 U.S.C. § 102**

Claim 1 stands rejected under 35 U.S.C. § 102(b), as being allegedly anticipated by Fujimoto et al. (Japanese Patent Application No. 3733071 // U.S. Patent No. 7,410,728, hereinafter "Fujimoto"). The Examiner states that Fujimoto discloses all of the elements of claims 1, primarily at col. 1-3 and in Figs. 6, 7, and 15-16. Office Action of July 20, 2010, p. 2. In making the rejection the Examiner also cites claims 2, 5 and 6, and thus the Applicants understand that the Examiner may have intended to reject claims 2, 5, and 6 over Fujimoto as well, and thus the Applicants also respond regarding claims 2, 5, and 6 if the rejection of claims 2, 5, and 6 was intended by the Examiner. Citations to Fujimoto herein are to U.S. Patent 7,410,728. Applicants respectfully traverse this rejection for at least the following reasons.

To anticipate a claim, a reference must disclose each and every limitation of the claim. *Lewmar Marine v. Varient Inc.*, 3 U.S.P.Q.2d 1766 (Fed. Cir. 1987). Moreover, the single source must disclose all of the claimed elements "arranged as in the claim." *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 716, 223 U.S.P.Q. 1264, 1274 (Fed. Cir. 1984).

Missing elements may not be supplied by the knowledge of one skilled in the art or the disclosure of another reference. *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 780, 227 U.S.P.Q. 773, 777 (Fed. Cir. 1985).

The Applicants disclose a method for improving the charge/discharge characteristics of a lithium secondary battery by surface-treating a surface of an anode current collector to provide a selected surface morphology. Specification, p. 8, lines 2-3. The Applicants disclose vapor-depositing a silicon film on the surface-treated anode current collector to provide an anode active material by sputtering during application of a bias voltage. Specification, p. 8, lines 3-5. The Applicants also disclose disposing an adhesive layer between the surface-treated anode current collector and a silicon film to reinforce bondability between the anode current collector and adhesive material. Specification, p. 8, lines 5-7.

The Applicants also disclose that the surface-treatment of the current collector by etching provides a Si thin film having an excellent self-organized micro-columnar structure, which reduces stress and tension caused by changes in volume during charge/discharge cycling of the battery. For instance, disclosed in Fig. 13 are results of the battery of Example 3, which provides excellent capacity preservability as compared to prior art batteries.

Amended independent claim 1 recites a method for improving charge/discharge cycle characteristics of a lithium secondary battery using a Si based anode active material, comprising surface-treating an anode current collector such that a surface morphology of the anode current collector has grain boundaries of 5 to 100  $\mu\text{m}$  size throughout an entire surface of the anode current collector, and trenches having a depth of more than 1  $\mu\text{m}$  formed at grain boundary junctions, wherein surface-treating is performed by chemical or electrical etching using a wet method, or by reactive gas or ion etching using a dry method.

In making the rejection the Examiner states that Fujimoto teaches a lithium secondary battery that uses Si as an anode active material at col. 1-3 of Fujimoto, and states that the surface morphology is taught to have a grain boundary between 5-100  $\mu\text{m}$  and a depth of more than 1  $\mu\text{m}$  in the images of surface morphology of Figs. 6,7, and 15-16 of Fujimoto. Office action of July 20, 2010, p. 2-3.

Fujimoto discloses a current collector having a surface roughness Ra of 0.001 to 1  $\mu\text{m}$ . Fujimoto, col. 2, line 47. Fujimoto also teaches that the current collector is preferably a nickel foil, states that the nickel foil may be electrolytic nickel foil, and states that the surface of the

nickel foil may be surface-roughened by depositing copper on a rolled nickel foil using an electrolytic process, for example. Fujimoto, col. 4, lines 50-65.

Fujimoto does not disclose, teach, or suggest applying a liquid etchant to the current collector, let alone surface-treating surface-treating by chemical or electrical etching using a wet method, or by reactive gas or ion etching using a dry method, as recited in amended independent claim 1. Fujimoto teaches preparing nickel foil by an electrolytic process or surface-roughening by depositing copper. Fujimoto, col. 4, lines 54 and 64-66.

In addition, the Applicants respectfully note that Figs. 6, 7, and 15-16 of Fujimoto, which are cited by the Examiner, are photomicrographs showing the surface of the silicon film, which is distinct from the current collector. See, for example, col. 7, lines 21-28 of Fujimoto, which recites, "FIG. 6 is a photomicrograph (at a magnification of 1,000 times) taken using a scanning electron microscope, **showing a silicon thin film** of an electrode in Reference Example when viewed from above; [and] FIG. 7 is a photomicrograph (at a magnification of 5,000 times) taken using a scanning electron microscope, **showing a silicon thin film** of an electrode in Reference Example when viewed from above." Fujimoto, col. 7, lines 21-28, emphasis added. Also, Fujimoto states with respect to Figs. 15-16, "FIG. 15 is a photomicrograph (at a magnification of 1,000 times) taken using a scanning electron microscope, showing **a silicon thin film surface** of an electrode a3 in Reference Example when viewed from above; [and] FIG. 16 is a photomicrograph (at a magnification of 1,000 times) taken using a scanning electron microscope, **showing a silicon thin film surface** of an electrode a6 in Reference Example when viewed from above." Fujimoto, col. 7, lines 53-60, emphasis added. Thus Figs. 6, 7, and 15-16 of Fujimoto show a silicon thin film, which is distinct from a current collector, such as the copper foil or nickel foil disclosed in Fujimoto. Thus Figs. 6, 7, and 15-16 of Fujimoto, or any other portion of Fujimoto does not disclose, teach, or suggest an anode current collector [which] has grain boundaries of 5 to 100  $\mu$ m size throughout an entire surface of the anode current collector, and trenches having a depth of more than 1  $\mu$ m formed at grain boundary junctions, wherein the surface-treating is performed by chemical or electrical etching using a wet method, or by reactive gas or ion etching using a dry method, as recited in amended independent claim 1.

Thus Fujimoto does not teach or suggest the specific morphology claimed by the Applicants, and the claimed grain boundary size is not shown in Figs. 6, 7, and 15-16 of

Fujimoto, as is alleged by the Examiner. Nor does Fujimoto disclose, teach, or suggest a method comprising surface-treating as claimed by the Applicants. Therefore, for at least these reasons, Fujimoto does not disclose, teach, or suggest a method for improving charge/discharge cycle characteristics of a lithium secondary battery using a Si based anode active material, comprising surface-treating an anode current collector such that a surface morphology of the anode current collector has grain boundaries of 5 to 100  $\mu\text{m}$  size throughout an entire surface of the anode current collector, and trenches having a depth of more than 1  $\mu\text{m}$  formed at grain boundary junctions, wherein surface-treating is performed by chemical or electrical etching using a wet method, or by reactive gas or ion etching using a dry method, as recited in amended independent claim 1.

Therefore, for at least these reasons, claim 1 defines over, is not anticipated by, and is non-obvious over Fujimoto for at least the reason that Fujimoto does not teach or suggest a method for improving the charge/discharge cycle characteristics of a lithium secondary battery using a Si based anode active material as claimed by the applicants. Claims 3-11 depend from claim 1, and thus include the allowable elements of claim 1. Therefore the dependent claims are patentable over the cited references for at least the reasons given above for amended independent claim 1. Also, claim 2 has been cancelled herewith.

Accordingly, reconsideration, withdrawal of the rejection of claim 1 under 35 U.S.C. § 102, and the rejection of claims 2, 5, and 6 if that was so intended by the Examiner, and allowance of the instant claims, are respectfully requested.

#### **Claim Rejections Under 35 U.S.C. § 103(a)**

Claim 4 stands rejected under 35 U.S.C. § 103(a), as being allegedly unpatentable over Fujimoto as stated on page 4 of the Office action dated July 20, 2010. Regarding claim 4, the Examiner states that the “applicant however established that it would be obvious to use Germanium or Silicon as active materials.” Office action of July 20, 2010, p. 4. In making the rejection the Examiner also cites claims 6-9 and 11, and thus the Applicants understand that the Examiner may have intended to reject claims 6-9 and 11 over Fujimoto as well. Thus the Applicants also respond regarding claims 6-9 and 11 if the rejection of claims 6-9 and 11 was intended by the Examiner. Applicants respectfully traverse this rejection for at least the following reasons.

For an obviousness rejection to be proper, the Examiner is expected to meet the burden of establishing why the differences between the prior art and that claimed would have been obvious. (MPEP 2141(III)) “A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR Int’l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007). To find obviousness, the Examiner must “identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does.” *Id.*

It is respectfully noted that claims 4, 6-9, and 11 depend from amended independent claim 1, which is allowable for defining over Fujimoto as discussed above.

Also, in making the rejection, the Examiner seems to imply that the disclosure of Fujimoto of electrode a8, which comprises a germanium thin film, in conjunction with the Applicants’ specification would render at least claim 4 obvious. The Applicants respectfully note that the Applicants’ disclosure pertains to a Si based anode active material and respectfully disagree that the Applicants disclosure states or suggests that results for a germanium thin film, such as is disclosed in Fujimoto, would be applicable to a silicon active material. The Applicants also respectfully note that the Examiner has not cited any portion of the Applicants’ disclosure to support this allegation.

Thus, for at least these reasons, claims 4, 6-9, and 11 are non-obvious and patentable over Fujimoto.

Accordingly, it is respectfully requested that the rejection to claim 4, and the rejection of claims 6-9 and 11, if that was so intended by the Examiner, under 35 U.S.C. § 103 be withdrawn, and the instant claims be allowed to issue.

Claims 2 and 3 stand rejected under 35 U.S.C. § 103(a), as being allegedly unpatentable over Fujimoto and further in view of Saito et al. (JP 2000336491, hereinafter “Saito”) as stated on pages 5-6 of the Office action dated July 20, 2010. The Examiner states that Fujimoto teaches a nickel or copper foil with an interlayer and silicon active material in that respective order, states that Fujimoto “has expressed the desire to increase adhesion between the foil and the current collector,” states that Fujimoto fails to teach applying a liquid etchant to the foil, states that Saito teaches a process of using an etching agent that comprises ferric chloride and hydrochloric acid to roughen the nickel surface, and states that it would have been obvious to

use this etchant in Fujimoto. Office action of July 20, 2010, p. 5-6. Applicants respectfully traverse this rejection for at least the following reasons.

Saito discloses an etching agent for roughening the surface of nickel to provide a roughened shape and “deep unevenness.” Saito, Abstract and Machine Translation, [0005]. Saito is directed to improving adhesiveness between nickel and a resin, to improve an “anchor effect.” Saito, Machine Translation, [0005]. The machine translation of Saito seems to disclose an aqueous solution of ferric chloride, hydrochloric acid, and a high polymer compound (Saito, [0007]), however the Applicants respectfully note that Saito is not related to a lithium secondary battery.

First, the Applicants respectfully note that claim 2 has been cancelled herewith, and that amended dependent claim 3 depends from amended independent claim 1, which is non-obvious and patentable over Fujimoto for at least the reasons discussed above.

Second, for the purposes of evaluating obviousness of claimed subject matter, the particular references relied upon must constitute “analogous art.” *In re Clay*, 966 F.2d 656, 659, 23 U.S.P.Q.2d 1058, 1060-61 (Fed. Cir. 1992). The art must be from the same field of endeavor, or be reasonably pertinent to the particular problem with which the inventor is involved. *Id.* Because Saito pertains to adhesion of nickel and a resin, and does not provide a teaching that would have prompted a skilled artisan to consider applying Saito to a lithium secondary battery, the Applicants respectfully assert that one of ordinary skill in the art would not have been prompted to consider Saito, let alone modify Fujimoto in view of Saito as suggested by the Examiner.

Further, the Applicants respectfully note that neither Fujimoto nor Saito teach or suggest the relationship between the surface morphology of the current collector and capacity preservation, and thus for this reason as well one of ordinary skill in the art would not have been prompted to combine the references in the manner suggested by the Examiner, let alone arrive at the invention claimed by the Applicants.

Accordingly, for at least these reasons, Fujimoto and Saito, either alone or in combination, do not render obvious the subject matter of amended independent claim 1. Claims 3-11 depend from claim 1, and thus include the allowable elements of claim 1. Thus the dependent claims are patentable over the cited references for at least the reasons given above for amended independent claim 1. Also, claim 2 has been cancelled herewith.

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Reconsideration, withdrawal of the rejection of claims 2-3 under 35 U.S.C. § 103, and allowance of the instant claims, are respectfully requested.

**Conclusion**

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and withdrawal of the objection(s) and rejection(s) and allowance of the case are respectfully requested.

Applicants hereby petition for any necessary extension of time required under 37 C.F.R. 1.136(a) or 1.136(b) or any other necessary fees(s), which may be required for entry and consideration of the present Reply.

If there are any additional charges due with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' Attorneys.

Respectfully submitted,

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